Comparing two geospatial approaches for delineating crop ecologies in Tanzania

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Outline

- **Introduction**
- **Methods**
- **Results**
- **Conclusions**

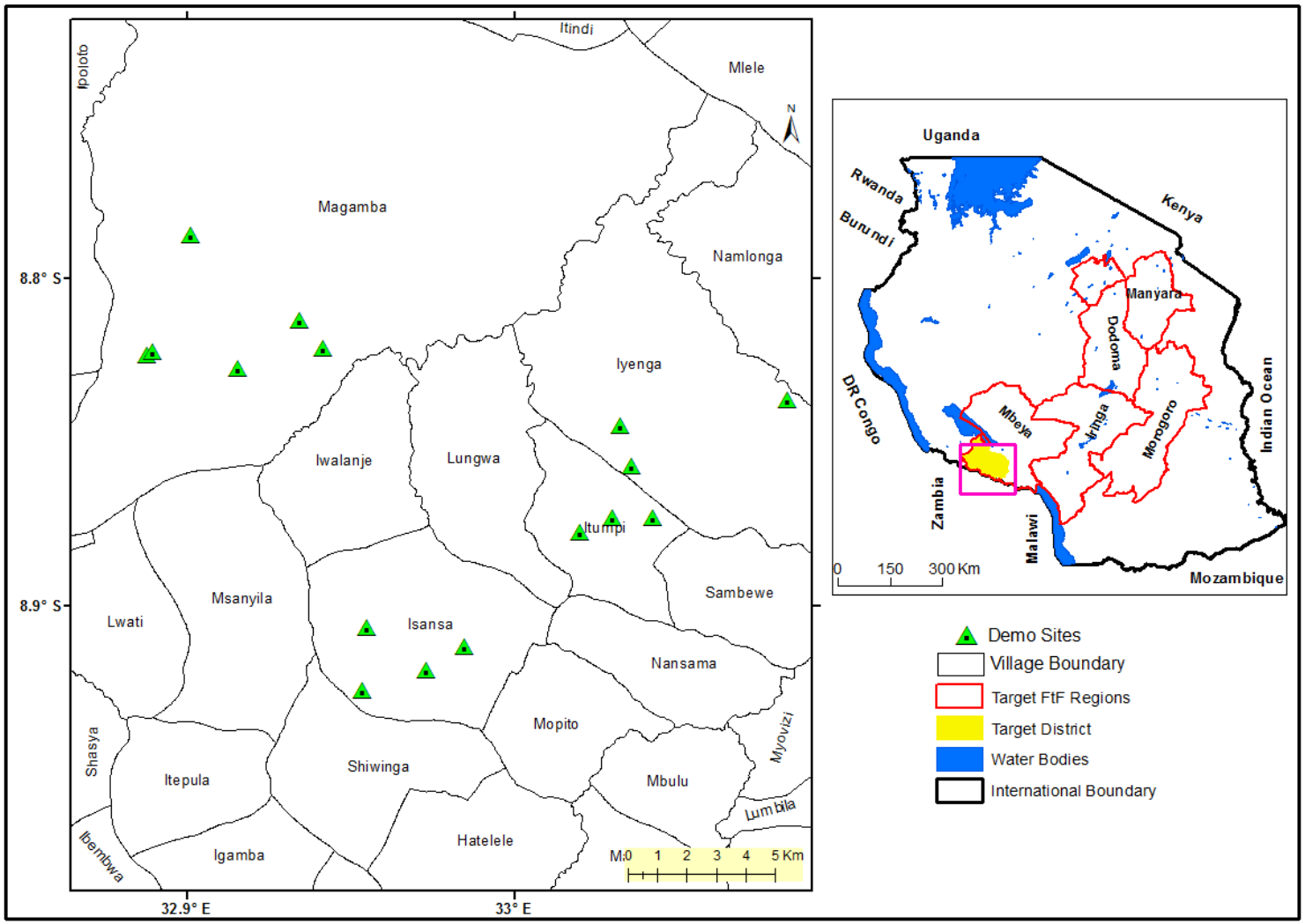
Introduction

- Adoption of improved crop varieties and good agronomic practices (GAPs) is one pathway to increase food production
    - Crop varieties & GAPs are environment specific

- Scaling improved agronomic practices in their suitable biophysical environments enhance adoption

- Mapping suitable zones for agronomic technologies improve spatial targeting
    - Which methods produce robust results in different context?

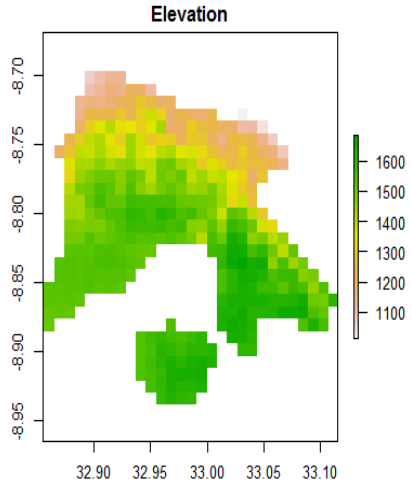
Study Area

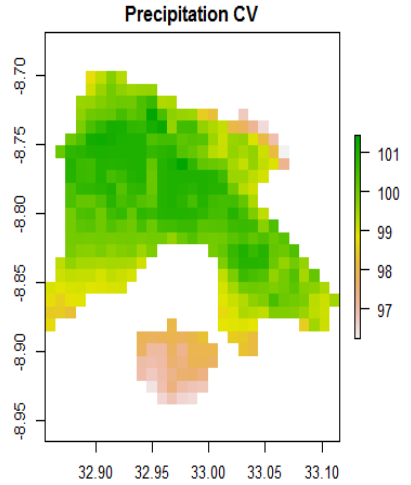

Itindi
Mlele
Ipololo
N
Magamba
Namlonga
8.8° S
Iyenga
Iwalanje
Lungwa
Itumpi
Sambewe
8.9° S
Lwati
Msanyila
Isansa
Nansama
Mopito
Myovizi
Shasya
Itepula
Shiwinga
Mbulu
Lumbila
Ibembwa
Igamba
Hatelele
0 1 2 3 4 5 Km
32.9° E
33° E
Uganda
Rwanda
Burundi
Kenya
Manyara
Dodoma
DR Congo
Mbeya
Iringa
Morogoro
Indian Ocean
Zambia
Malawi
0 150 300 Km
Mozambique
Demo Sites
Village Boundary
Target FtF Regions
Target District
Water Bodies
International Boundary

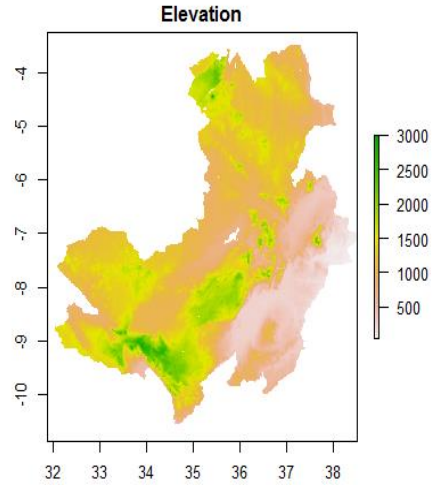
Data: Candidate agronomic technologies

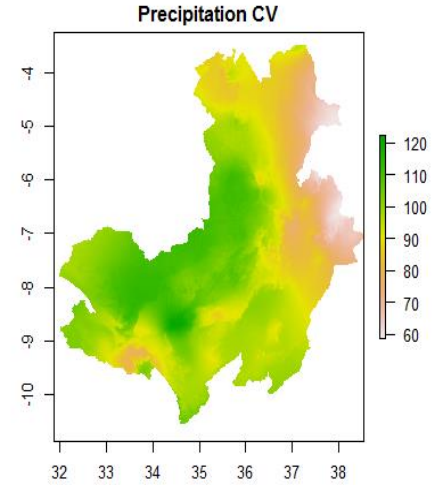
Variety	Grain yield (t/ha)	Optimal biophysical range			Fertilizer type	Treatment ID
		Altitude (a.s.l.)	Rainfall (mm)	Maturity (days)		
HB 614	7	>1500	>800	180-190	DAP+ Urea	Ver1Fer1
					YaramilaCereal + Sulfan	Ver1Fer2
MERU 513	11	800-1200	700-1500	100-110	DAP+ Urea	Ver2Fer1
					YaramilaCereal + Sulfan	Ver2Fer2
PAN 691	7	>1500	800-1500	103	DAP+ Urea	Ver3Fer1
					YaramilaCereal + Sulfan	Ver3Fer2
SC 719	4.5-5.0	800-1500	800-1200	145-152	DAP+ Urea	Ver4Fer1
					YaramilaCereal + Sulfan	Ver4Fer2
UH 615	8.0-9.0	1200-1800	>800	85-92	DAP+ Urea	Ver5Fer1
					YaramilaCereal + Sulfan	Ver5Fer2
UH 6303	9.0-10.0	1200-1800	>800	92	DAP+ Urea	Ver6Fer1
					YaramilaCereal + Sulfan	Ver6Fer2

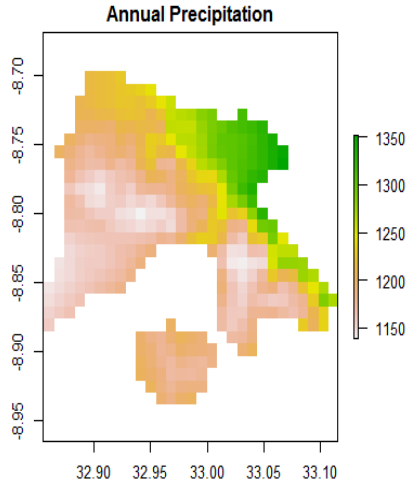
Data: Reference site and projection domain

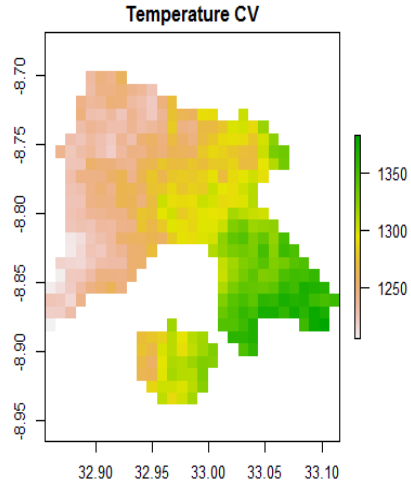


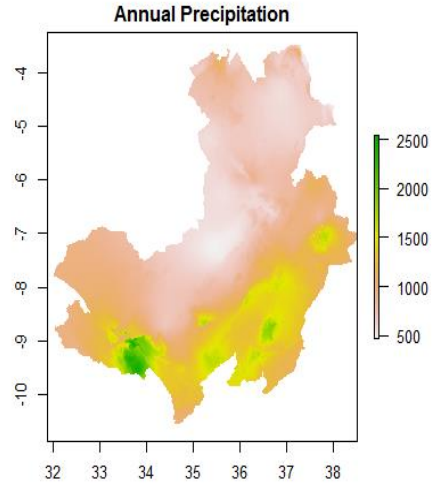


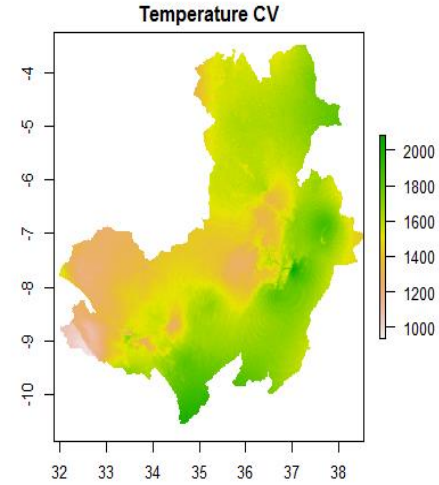




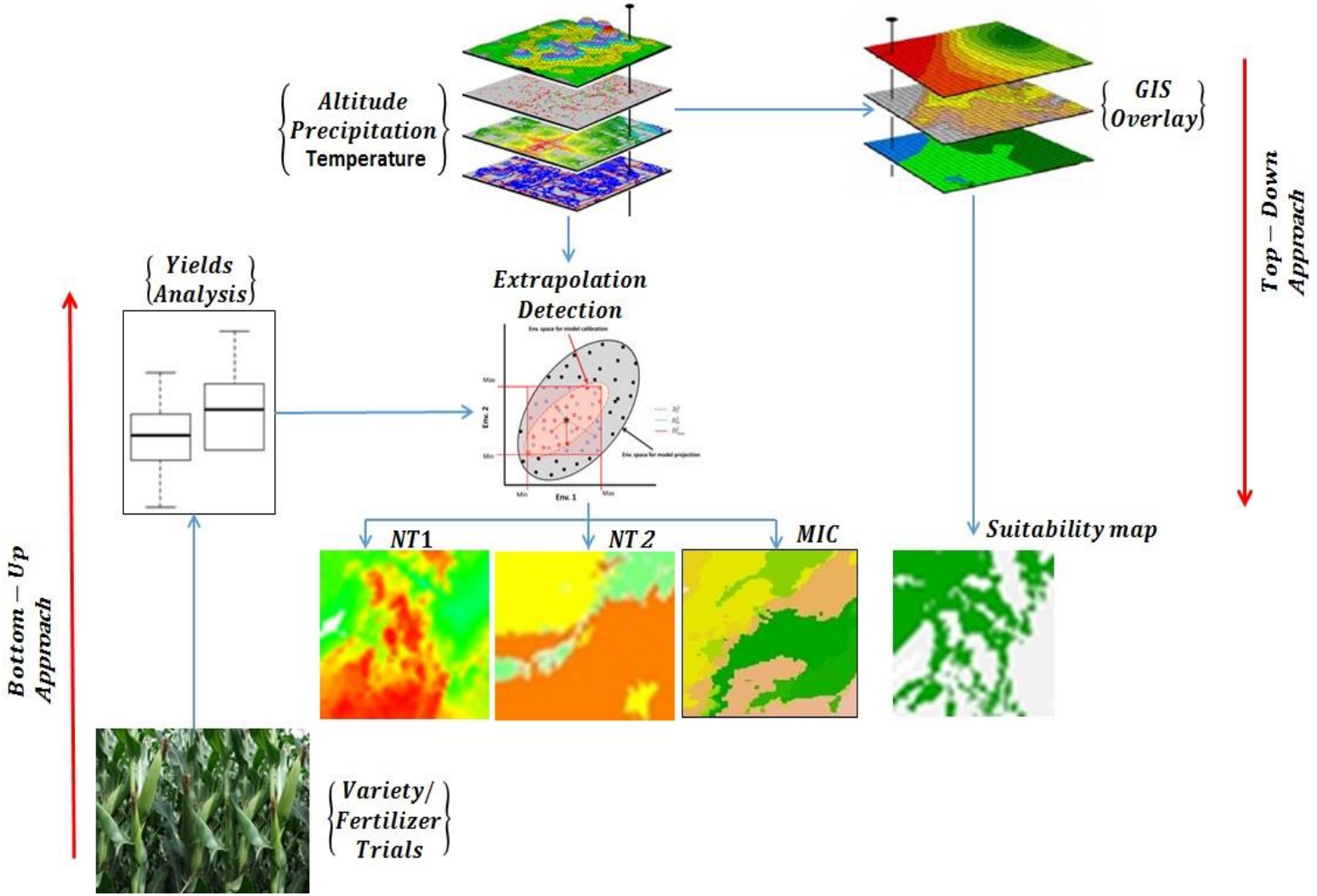






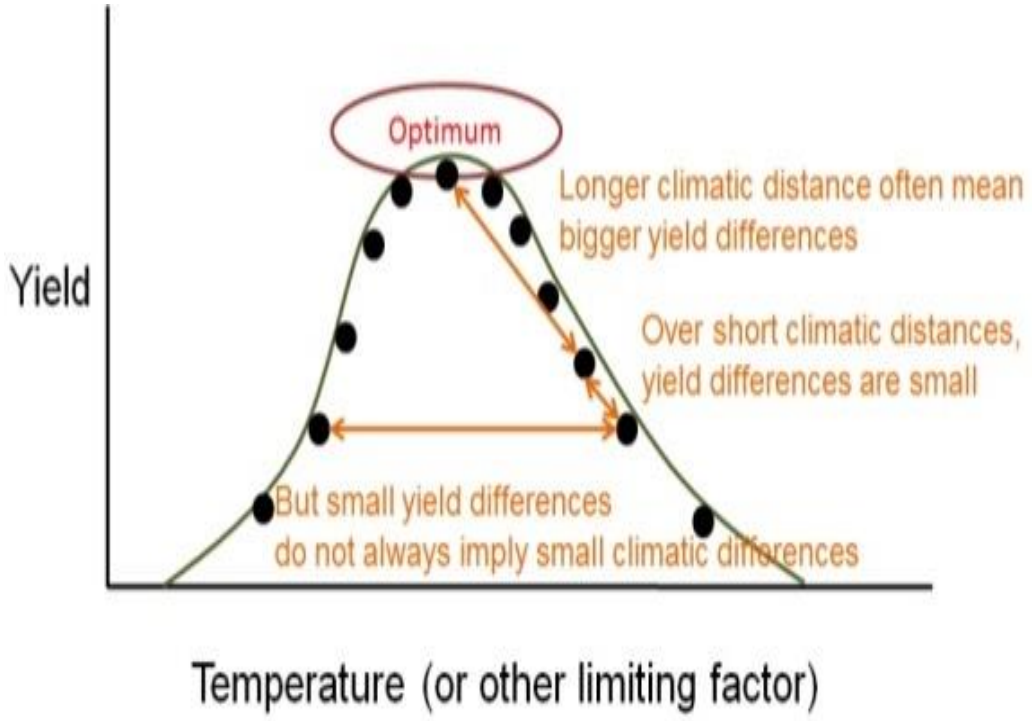


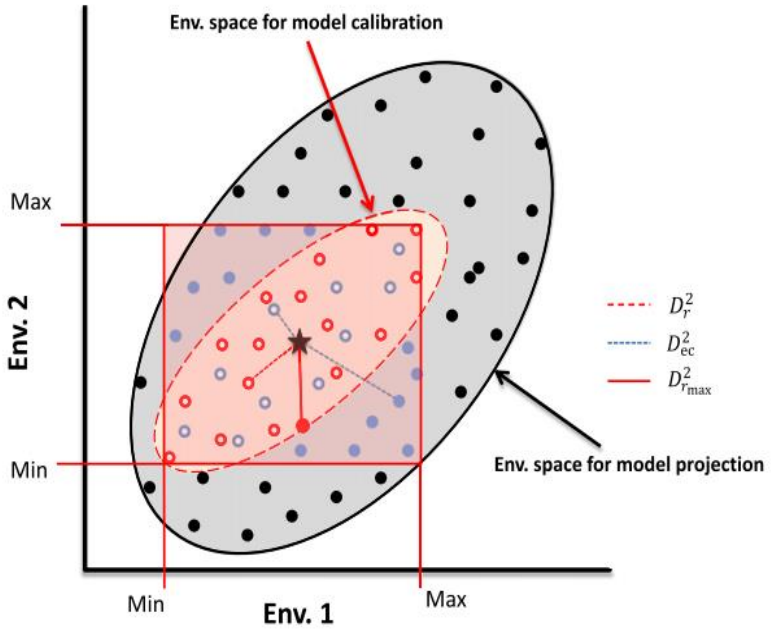
Methods: Top-down and Bottom-up approaches



Bottom-up approach: Extrapolation Detection

- Use extrapolation detection (ExDet) tool to derive environmental (dis)similarity between reference trial/demo sites & with projection domains to identify potential adaptation sites

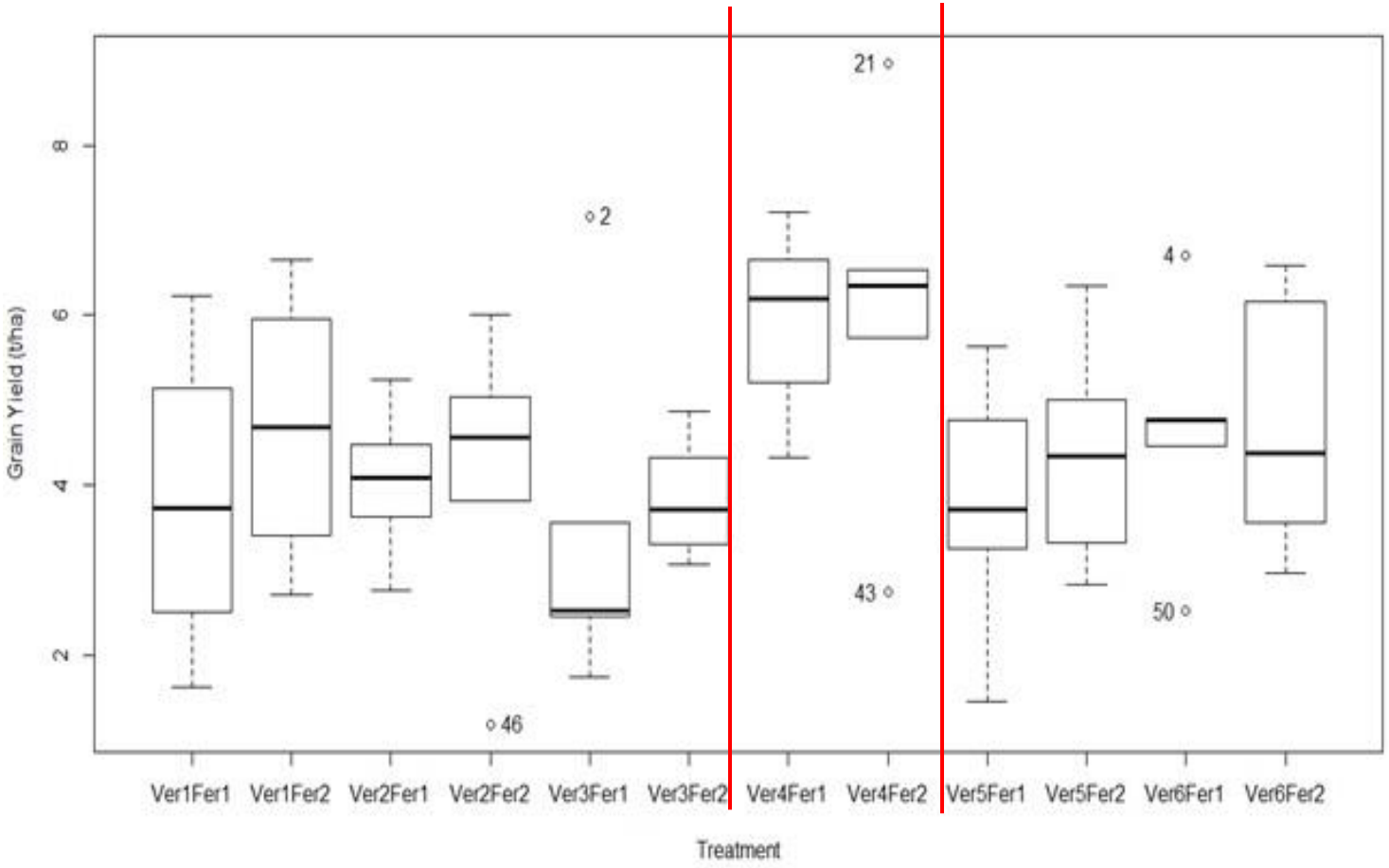




Mesgaran et al 2014

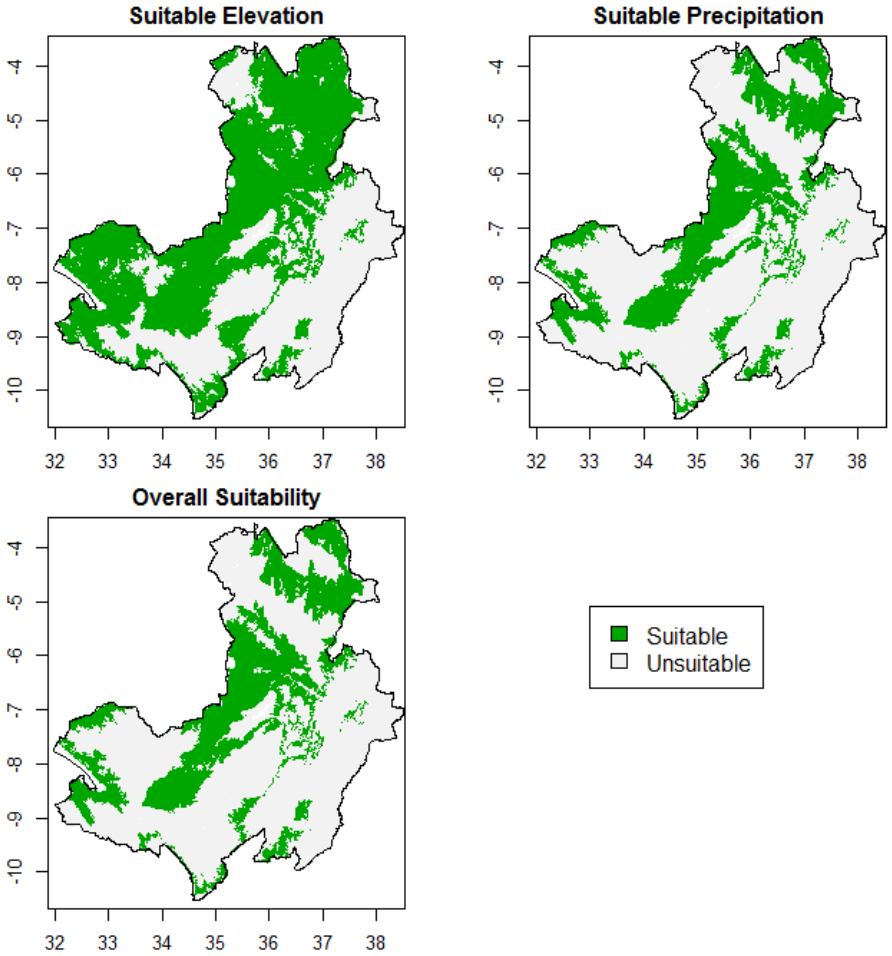
Results: Best-bet agronomic technology package

- SC719 maize variety with application of Yaramila-Cereal and Sulfan fertilizers emerged the best performing technology at reference site based on yields



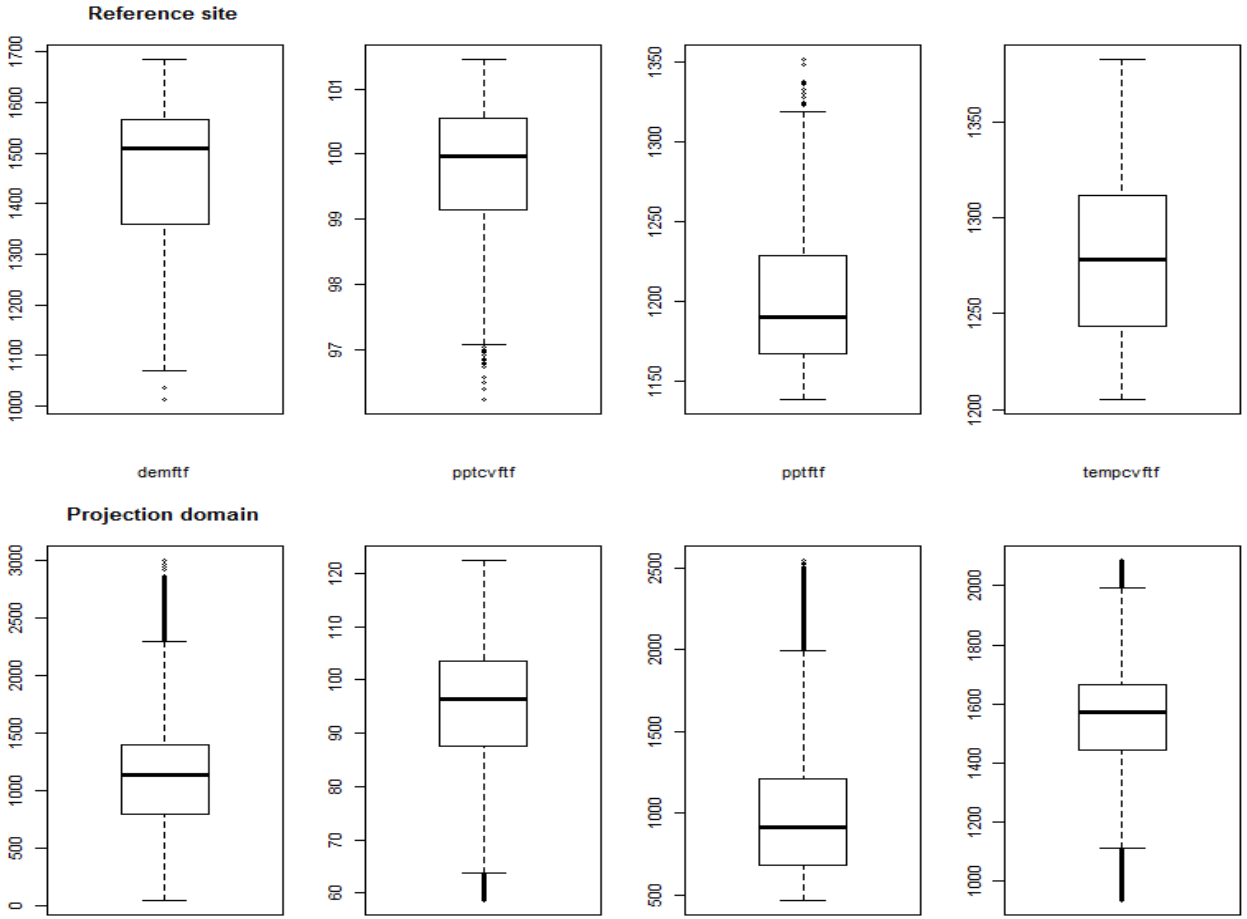
Results: Suitability from top-down approach

- 15% (89782 Km^2) of FtF zone suitable for SC 719 maize variety plus two fertilizers



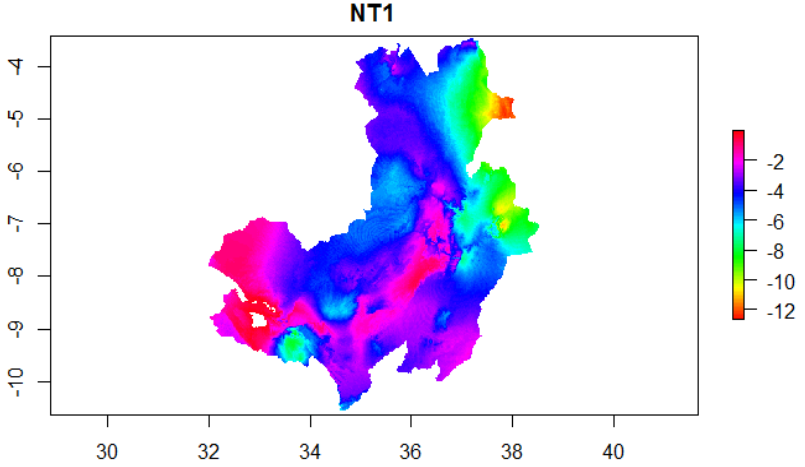
Results: Bottom-up approach

- Variables had lower variance in reference site compared to projection domain

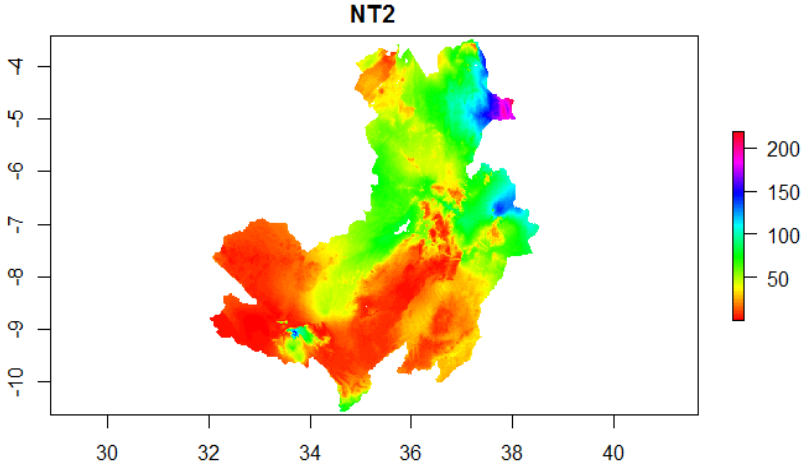


Results: Bottom-up approach

- NT1 novelty depict dissimilarity in univariate range of covariates while NT2 novelty reveal degree of novel combinations of covariates compared to reference site



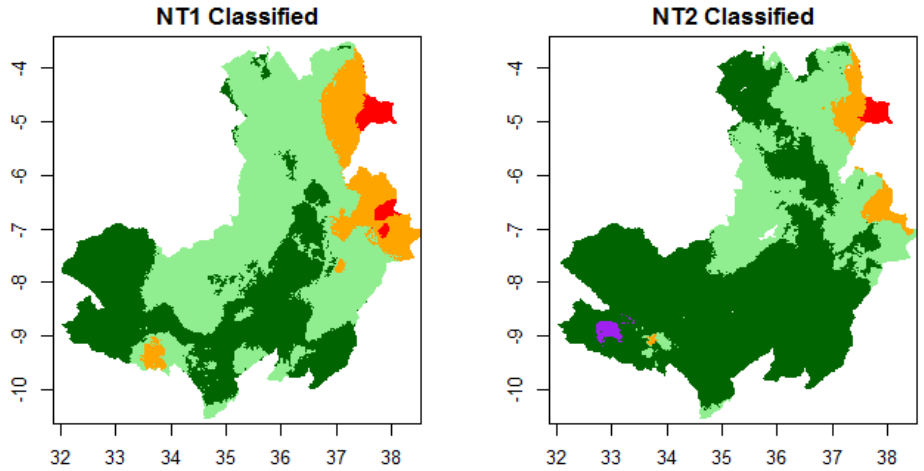
- NT1 value = 0 is most suitable

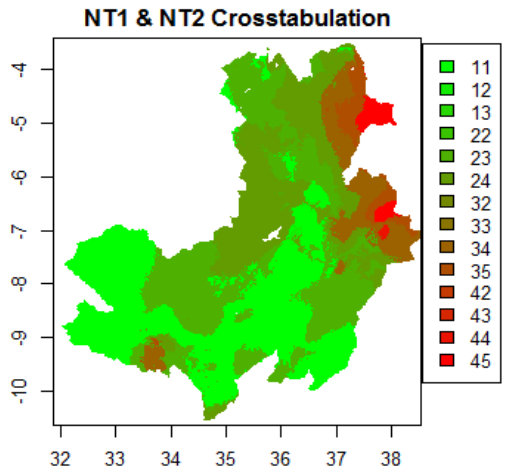


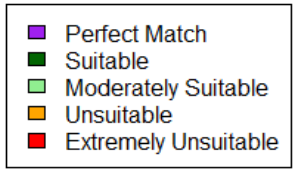
- NT2 values 0 - 1 is perfect match to reference site
- Degree of unique combinations of covariates increases with ascending NT2 values

Results: Bottom-up approach

- Crop suitability gradient derived by intersection of NT1 & NT2 classes
  - Class 11 the best & 45 the least suitable for SC719 maize+ Fertilizers



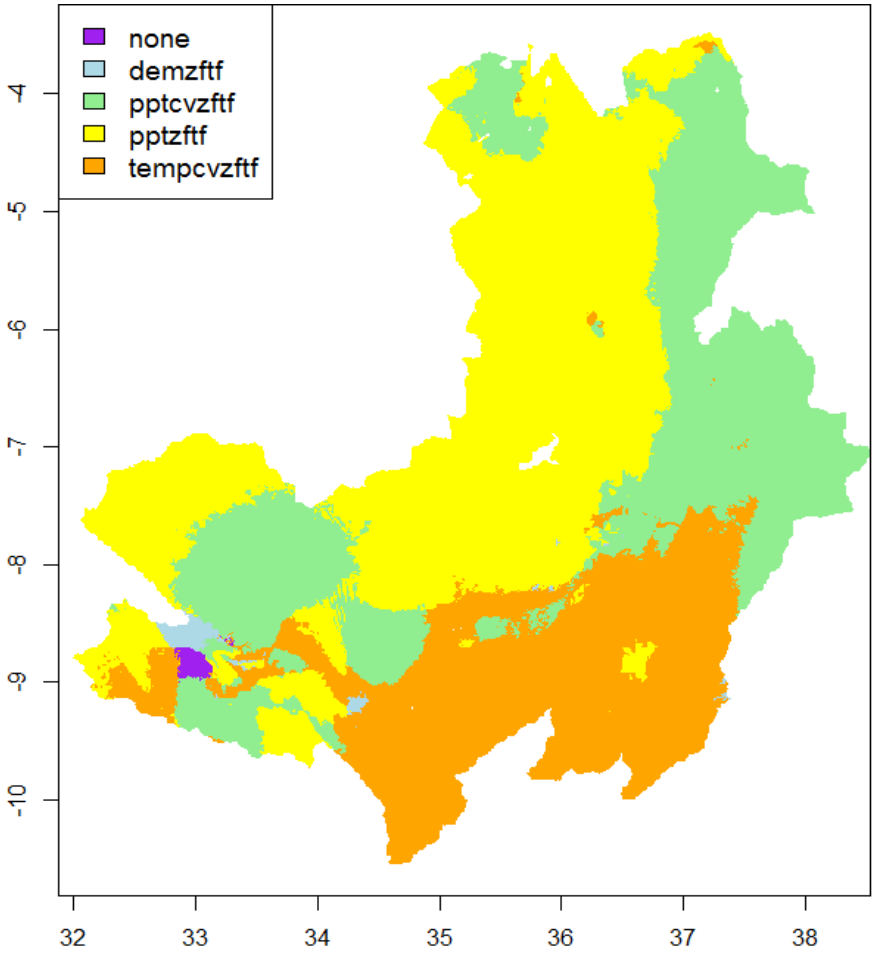




Class	Area (Km²)
11	1843
12	98604
13	1009
22	80870
23	58007
24	127
32	2690
33	20046
34	9097
35	7
42	41
43	453
44	2647
45	2429

Results: Bottom-up approach

- Annual precipitation was most limiting covariate in largest area of FtF zone



Class	Code	Area (Km^2)
None	None	748
Elevation	demzftf	1729
Precipitation seasonality	pptcvzftf	88731
Annual Precipitation	pptzftf	118165
Temperature seasonality	tempcvftf	68497
No data	NA	316412
	Total	**594282**

Conclusions

- Bottom-up approach produce more ecologically meaningful results that consider dissimilarities in univariate range & correlations between covariates
  - Quantify risk of extrapolating beyond the range of reference environment
  - Knowledge on most limiting factor guide design of remedial actions e.g. irrigation
  - Application limited by sparse technology trial

- Top-bottom approach suited for locations with sparse trials data & considerable a-priori knowledge on optimal environmental requirements candidate technologies

Enhancing partnership among Africa RISING, NAFAKA and TUBORESHE CHAKULA Programs for fast tracking delivery and scaling of agricultural technologies in Tanzania

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